The Behaviour of Gases

A. Matching

Match each term in Column B with the correct description in Column A. Write the letter of the correct term in the blank provided. **(1 mark each)**

Column A	Column B
___ **1.** ideal gas constant (R)	**a**. The volume of a fixed mass of gas is directly proportional to the Kelvin temperature if the volume is kept constant.
___ **2.** Boyle's law	b. At constant volume and temperature, the total pressure exerted by a mixture of gases is equal to the sum of the partial pressures.
___ **3.** Dalton's law of partial pressures	**c.** $\frac{8.31 L \times kPa}{K \times mol}$
___ **4.** ideal gas law	**d.** the contribution each gas in a mixture makes to the total pressure
___ **5.** combined gas law	**e.** A gas tends to move to an area of lower concentration until the concentration is uniform.
___ **6.** Charles's law	**f.** $\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$
___ **7.** diffusion	**g.** $P \times V = n \times R \times T$
___ **8.** partial pressure	**h.** For a given mass of gas at constant temperature, the volume of gas varies inversely with pressure.

B. Multiple Choice

9. As the temperature of a fixed volume of gas increases, the pressure will:

a. vary inversely
b. decrease
c. remain the same
d. increase

10. A breathing mixture used by deep-sea divers contains helium, oxygen, and carbon dioxide. What is the partial pressure of oxygen at 101.3 kPa total pressure if P_{He} = 84.0 kPa and P_{CO2} = 0.10 kPa?

a. 10.3 kPa
b. 17.2 kPa
c. 34.4 kPa
d. 185.4 kPa

11. Increasing the volume of a given amount of gas at constant temperature causes the pressure to decrease because:

a. the molecules are striking a larger area with the same force
b. there are fewer molecules
c. the molecules are moving more slowly
d. there are more molecules

12. When a container is filled with 3.00 mol of H_2 , 2.00 mol of O_2 , and 1.00 mol of N_2 , the pressure in the container is 465 kPa. The partial pressure of O_2 is:

a. 78 kPa
b. 116 kPa
c. 155 kPa
d. 212 kPa

13. A box with a volume of 22.4 L contains 1.0 mol of nitrogen and 2.0 mol of hydrogen at 0 °C. Which of the following statements is true?

a. the total pressure in the box is 202.6 kPa
b. the partial pressures of H_2 and N_2 are equal
c. the total pressure is 101.3 kPa
d. the partial pressure of N_2 is 101.3 kPa

14. The volume of a gas is doubled while the temperature is held constant. The pressure of the gas:

a. remains unchanged
b. is reduced by one-half
c. is doubled
d. depended on the kind of gas

15. As the temperature of the gas in a balloon decreases:

a. the volume increases.
b. the pressure increases.
c. the average kinetic energy of the gas particles decreases.
d. All of the above are true.

16. The volume of gas is increases from 0.5 L to 4.0 L while the temperature is held constant. The pressure of the gas:

a. increases by a factor of four
b. decreases by a factor of eight
c. increases by a factor of eight
d. increases by a factor of two

17. A gas occupies 40.0 mL at -123 °C. What volume does it occupy at 27 °C, assuming pressure is constant?

a. 182 mL
b. 8.80 mL
c. 80.0 mL
d. 20.0 mL

18. A gas occupies a volume 0.2 L at 25 kPa. What volume will the gas occupy at 2.5 kPa?

a. 4 L
b. 20 L
c. 2 L
d. 0.02 L

19. Which of these changes would not cause an increase in the pressure of a gaseous system?

a. Another gas is added to the container.
b. Additional amounts of the same gas are added to the container.
c. The temperature is increased.
d. The container is made larger.

20. At a certain temperature and pressure, 0.20 mol of CO_2 has a volume of 3.1 L. A 3.1-L sample of hydrogen at the same temperature and pressure:

a. has a higher density
b. contains the same number of molecules
c. has the same mass
d. contains the same number of atoms

21. If a balloon containing 1000 L of gas at 50 °C and 101.3 kPa rises to an altitude where the pressure is 27.5 kPa and the temperature is 10 °C, its volume there is:

a. $1000\,L \times \frac{27.5\,kPa}{101.3\,kPa_1}$

b. $1000\,L \times \frac{283\,K}{323\,K} \times \frac{101.3\,kPa}{27.5\,kPa}$

c. $1000\,L \times \frac{27.5\,kPa}{101.3\,kPa} \times \frac{323\,K}{283\,K}$

d. $1000\,L \times \frac{50°C}{10°C} \times \frac{101.3\,kPa}{27.5\,kPa}$

C. Problems

Solve the following problems in the space provided. Show your work. **(3 marks each)**

22. A gas has a pressure of 655 kPa at 227 °C. What will its pressure be at 27 °C, if the volume does not change?

23. A 10 g mass of krypton occupies 15.0 L at a pressure of 156 kPa. Find the volume of the krypton when the pressure is increased to 215 kPa at the same temperature.

24. A gas occupies a volume of 180 mL at 35.0 °C and 95.5 kPa. What is the volume of the gas at conditions of STP?

Part C: Calculation Problems

In these problems, please be certain to show the (a) original form of a formula
(b) any formula rearrangements
(c) any unit cancellations

1. A sample of CO_2 gas is heated from 23.45 °C to a new temperature. The volume changed from 354 mL to 567 mL; pressure was constant during the heating process. What is the new and higher temperature which effected such volume change? **(3 marks)**

2. Gaseous ammonia is synthesized to form nitrogen and hydrogen by the reaction of

$$N_{2\,(g)} + 3H_{2\,(g)} \longrightarrow 2NH_{3\,(g)}$$

Assume that you take 355 L of H_2 gas at 25 °C and 542 mm Hg and combine it with 105 L of N_2 gas measured at 20.0 °C and a pressure of 645 mm Hg. How many grams of NH_3 gas could be obtained in theory? If the ammonia gas is collected in a 125 L tank at 25 °C, what would be its pressure? **(8 marks)**

3. A gas at 234 mL is exposed to a temperature change of 23 to 56 °C while also experiencing a pressure change of 101.3 kPa to 129.6 kPa. What is the new gas volume? **(3 marks)**

4. Complete the missing values in the table. **(6 marks)**

Law	Equation	Constant variables	Variables that change	Derived equation
Boyle's law		*n, T*	*P, V*	
Charles's law	$V \propto T$		*T, V*	$\frac{V_1}{T_1} = \frac{V_2}{T_2}$
Avogadro's principle	$V \propto n$	*P, T*	*n, V*	
Combined gas law		*n*		$\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$

5. Oxygen gas is generated in the lab by the thermal decomposition of potassium chlorate, $KClO_3$. What volume of oxygen gas (at STP) is generated from 1.00 g of potassium chlorate in the reaction. The other decomposition product is a simple slat, potassium chloride. **(6 marks)**